Testing to see if your die is fair...

Ch. 9 Section 0: Chi-Square Goodness of Fit Test

χ^2 chi

- **Testing whether…** (#)
  a frequency distribution fits an expected distribution.

Hypothesis — written out

- (=) **Ho:** the observed frequency distrib. of ___ fits the expected distribution.

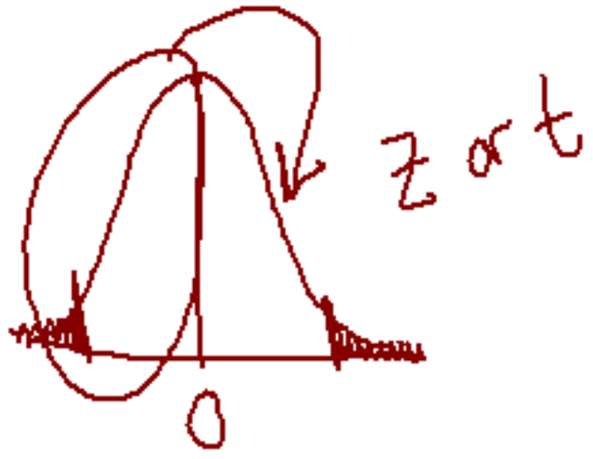
- (≠) **Ha:** the obs. freq. distrib. of ___ doesn't fit the exp. distrib.

Test Statistic

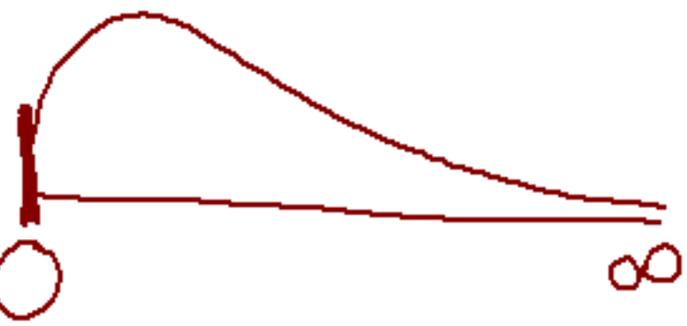
- $\chi 2 = \sum \frac{(\text{observed} - \text{expected})^2}{\text{expected}}$

  # # #

  * for each category



- **Distribution:** χ^2 distribution



- **df =** $k - 1$

  # of categories

~~n ≥ 60~~

P-value $P(\chi^2 > \underline{\text{test stat}} \mid df = \quad) =$

- **On calculator:** $\chi^2cdf(LB, UB, df)$
  - LB = test stat
  - UB = $\epsilon 99$
- **Always….**

use above test stat.

Conclusion

- same
- Suff. evid.... (recopy H_0 or H_a)

Assumptions

- SRS
- (n large enough that) all expected counts ≥ 5

✓

Example #1

Unfair Die

L2 L1

Outcome	Expected %	Expected #	Observed #
1	0.05	15	23
2	0.15	45	50
3	0.1	30	42
4	0.15	45	65
5	0.05	15	20
6	0.5	150	100
Total	**1**	**300**	**300**

$$\chi^2 = \sum_{exp} \frac{(obs - exp)^2}{exp}$$

$\chi^2 =$

Outcome	Obs	Exp	Obs-Exp	$(Obs-Exp)^2$	$(O-E)^2/E$
1					
2					
3					
4					
5					
6					

$\chi^2 =$ **df =**

P-Value:

Example #2:

A professor of education classes at Virginia Tech wants to look at what types of education the VT students are choosing. From previous studies, the types of education have been known to have the following distribution: 25% physical education, 15% math education, 15% science education, 5% art education, 20% special education, 10% history education, 5% foreign language education, and 5% other. He takes a random sample of 124 education majors and finds the following results: 40 phys ed, 20 math, 10 foreign language, 30 special ed, 15 history, 20 science, 10 art, and 9 other. Has the distribution of education majors changed? Run a full test of significance.

	L_1 Obs #	L_2 Exp #
PEd	40	38.5
MEd	20	23.1
ScEd	20	23.1
ArEd	10	7.7
SpEd	30	30.8
Hist Ed	15	15.4
FlEd	10	7.7
Other	9	7.7

Ho: the obs. freq. distrib. of Ed majors fits the exp. distrib.

Ha: the obs. freq. distrib. of Ed. majors doesn't fit the exp. distrib

$$\chi^2 = \sum \frac{(obs. - exp.)^2}{exp.} = 2.5152$$

$P(\chi^2 > 2.5152 \mid df = 7) = 0.926$

- fail to reject
- recopy Ho

Try #1 and 3 on the worksheet.

HW: separate HW worksheet, #1, 2, 3.
Do work on separate paper

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① $\chi^2 = 8.903$

$df = 4$

P-value = 0.06357

② $\chi^2 = 0.2995$

$df = 3$

p-value = 0.96